

CLAIMS

WHAT IS CLAIMED:

1. A method for scheduling production flow, comprising:
processing a plurality of manufactured items in a process flow;
determining item health metrics for at least a subset of the plurality of manufactured items;
determining tool health metrics for a plurality of tools in the process flow; and
scheduling the manufactured items for processing in the tools based on the item health metrics and the tool health metrics.
2. The method of claim 1, wherein determining the item health metrics further comprises:
measuring characteristics of a plurality of manufactured items in the process flow;
estimating the item health metrics for the plurality of manufactured items based on the measured characteristics.
3. The method of claim 2, wherein estimating the item health metrics further comprises estimating at least one of a grade parameter and a yield parameter.
4. The method of claim 2, wherein measuring the characteristics comprises measuring a physical characteristic of the manufactured items.
5. The method of claim 4, wherein the manufactured items comprise semiconductor devices, and measuring the physical characteristic comprises measuring at

least one of a transistor gate critical dimension, a process layer thickness, a particle contamination count, and a transistor active region dimension.

6. The method of claim 2, wherein measuring the characteristics comprises
5 measuring at least one of an implant dose and energy, and an anneal temperature and time

7. The method of claim 2, wherein measuring the characteristics comprises
measuring an electrical characteristic of the manufactured items.

10 8. The method of claim 7, wherein the manufactured items comprise
semiconductor devices, and measuring the electrical characteristic comprises measuring at
least one of a transistor effective channel length, a drive current, an insulating layer dielectric
constant, a transistor overlap capacitance, a regional material resistivity, a transistor threshold
voltage, an n-channel to p-channel drive current ratio, an off-state transistor leakage current,
15 and electrical charge carrier mobility measurement, and an oscillator test circuit frequency.

9. The method of claim 2, further comprising periodically measuring the
characteristics of the manufactured items and updating the item health metrics as the
manufactured items progress through the process flow.

20 10. The method of claim 1, wherein processing the plurality of manufactured
items comprises processing at least one of a plurality of microprocessors, a plurality of
memory devices, a plurality of digital signal processors, and a plurality of application specific
integrated circuits.

11. The method of claim 1, wherein the plurality of manufactured items are grouped into lots, and the determining the item health metric further comprises determining a lot health metric.

5 12. The method of claim 11, wherein scheduling the manufactured items for processing in the tools further comprises grouping lots with similar lot health metrics for processing in a selected tool.

10 13. The method of claim 1, wherein scheduling the manufactured items for processing in the tools further comprises grouping items with similar item health metrics for processing in a selected tool.

14. The method of claim 1, wherein determining the tool health metrics further comprises:

15 generating a tool state trace related to the processing of a selected manufactured item in a selected tool;

comparing the tool state trace to a tool health model associated with the selected tool; and

generating the tool health metric based on the comparison between the tool state trace and the tool health model.

20 15. The method of claim 14, wherein generating the tool state trace further comprises measuring a parameter of the selected tool during the processing of the selected manufactured item.

16. The method of claim 15, wherein comparing the tool state trace to the tool health model further comprises predicting a parameter of the tool during the processing of the selected manufactured item and comparing the measured parameter to the predicted parameter.

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17. The method of claim 1, wherein scheduling the manufactured items for processing in the tools further comprises:

comparing the item health metric associated with a selected manufactured item to a predetermined threshold;

determining a high performing tool based on the tool health metrics; and

scheduling the selected manufactured item in the high performing tool responsive to the item health metric exceeding the predetermine threshold.

18. The method of claim 1, wherein scheduling the manufactured items for processing in the tools further comprises:

ranking the tools in order of performance based on the tool health metrics;

ranking the manufactured items in order of health based on the item health metrics; and

scheduling the manufactured items in the tools based on the performance rankings and the health rankings.

19. The method of claim 18, wherein scheduling the manufactured items further comprises giving preference to the manufactured items with relatively higher item health metrics to tools with relatively higher tool health metrics.

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20. The method of claim 18, wherein ranking the manufactured items further comprises ranking each manufactured item based on its item health metric and at least one of a priority associated with the manufactured item and an age associated with the manufactured item.

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21. A manufacturing system, comprising:

a plurality of tools for processing a plurality of manufactured items in a process flow;
an item health monitor configured to determine item health metrics for at least a subset of the plurality of manufactured items;
a tool health monitor configured to determine tool health metrics for at least a subset of the plurality of tools; and
a scheduling server configured to schedule the manufactured items for processing in the tools based on the item health metrics and the tool health metrics.

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22. The system of claim 21, wherein the item health monitor is further configured to access measurements of a characteristic of a plurality of manufactured items in the process flow and estimate the item health metrics for the plurality of manufactured items based on the measurements.

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23. The system of claim 22, wherein the item health monitor is further configured to determine the item health metrics based on at least one of a grade parameter and a yield parameter.

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24. The system of claim 22, wherein the characteristic further comprises a physical characteristic of the manufactured items.

25. The system of claim 24, wherein the manufactured items comprise semiconductor devices, and the physical characteristic comprises at least one of a transistor gate critical dimension, a process layer thickness, a particle contamination count, and a transistor active region dimension.

26. The system of claim 22, wherein the characteristic comprises at least one of an implant dose and energy, and an anneal temperature and time

27. The system of claim 22, wherein the characteristic comprises an electrical characteristic of the manufactured items.

28. The system of claim 27, wherein the manufactured items comprise semiconductor devices, and the electrical characteristic comprises at least one of a transistor effective channel length, a drive current, an insulating layer dielectric constant, a transistor overlap capacitance, a regional material resistivity, a transistor threshold voltage, an n-channel to p-channel drive current ratio, an off-state transistor leakage current, and electrical charge carrier mobility measurement, and an oscillator test circuit frequency.

29. The system of claim 22, wherein the item health monitor is further configured to periodically access measurements of the characteristics of the manufactured items and update the item health metrics as the manufactured items progress through the process flow.

30. The system of claim 21, wherein the plurality of manufactured items comprise at least one of a plurality of microprocessors, a plurality of memory devices, a plurality of digital signal processors, and a plurality of application specific integrated circuits.

5 31. The system of claim 21, wherein the plurality of manufactured items are grouped into lots, and the item health metric further comprises a lot health metric.

32. The system of claim 31, wherein the scheduling server is further configured to group lots with similar lot health metrics for processing in a selected tool.

10 33. The system of claim 21, wherein the scheduling server is further configured to group items with similar item health metrics for processing in a selected tool.

15 34. The system of claim 21, wherein the tool health monitor is further configured to access a tool state trace related to the processing of a selected manufactured item in a selected tool, compare the tool state trace to a tool health model associated with the selected tool, and generate the tool health metric based on the comparison between the tool state trace and the tool health model.

20 35. The system of claim 34, wherein the tool state trace further comprises a parameter of the selected tool measured during the processing of the selected manufactured item.

36. The system of claim 35, the tool health monitor is further configured to predict a parameter of the tool during the processing of the selected manufactured item and compare the measured parameter to the predicted parameter.

5 37. The system of claim 21, wherein the scheduling server is further configured to compare the item health metric associated with a selected manufactured item to a predetermined threshold, determine a high performing tool based on the tool health metrics, and schedule the selected manufactured item in the high performing tool responsive to the item health metric exceeding the predetermined threshold.

10 38. The system of claim 21, wherein the scheduling server is further configured to rank the tools in order of performance based on the tool health metrics, rank the manufactured items in order of health based on the item health metrics, and schedule the manufactured items in the tools based on the performance rankings and the health rankings.

15 39. The system of claim 38, wherein the scheduling server is further configured to give preference to the manufactured items with relatively higher item health metrics to tools with relatively higher tool health metrics.

20 40. The method of claim 38, wherein the scheduling server is further configured to rank each manufactured item based on its item health metric and at least one of a priority associated with the manufactured item and an age associated with the manufactured item.

41. A manufacturing system, comprising:
means for processing a plurality of manufactured items in a process flow;

means for determining item health metrics for at least a subset of the plurality of
manufactured items;

means for determining tool health metrics for a plurality of tools in the process flow;

and

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means for scheduling the manufactured items for processing in the tools based on the
item health metrics and the tool health metrics.

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